

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	

The invention is of particular interest when there is an existing telecommunication system that needs to be expanded by adding new switches to the existing system. The added switches may be of other kinds (STM, ATM, IP) than those used in the existing telecommunication system. To expand an existing telecommunication system in this manner is a formidable task, requiring redesign of a large part of the software running in the existing telecommunication system. An object of the present invention is to allow the addition and control of new switches in new nodes to an existing telecommunication system only minor redesign of the existing software in the telecommunication system to which new switches in new nodes are added and controlled. By re-use of existing software the development costs are reduced. In particular the traffic control functions of the existing telecommunication system shall be re-used, that is shall remain unaffected by the addition of the new switches in the new nodes. However, the existing software for control of connections has to be redesigned. This object is achieved with the means indicated in the enclosed independent claims.

For example in a public telephone network using STM switches the switches that are added to the telephone network may be ATM switches or IP based switches that form a part of a data network. The STM switches have software for call control and call services, the added ATM switches or IP based switches have not. ATM switches are used for data traffic and do not have functions for call control and call services. In accordance with the invention the traffic control functions used in the telephony network are used also for call control of the added ATM switches. This with minor redesign of the software of the STM switches and the ATM switches. In accordance with the invention this is made possible by hiding the added switches so they cannot be

seen by the traffic control system in STM switches. A connection handler in accordance with the invention will provide the hiding of the added switches. The added new switches are addressed by the traffic control functions in the same manner as the switches in the existing telecommunication system are addressed. In the existing telecommunication system a switch is controlled by addressing its multiple points, MUPs. In accordance with the invention the added new switches are controlled by addressing virtual MUPs, vMUPs. These belong to a global address space. To the system functions it does not matter if MUPs or vMUPs are addressed, they all look the same to the traffic system. In fact all switches, those already existing as well as those which have been added, look like one big switch to the traffic control system. The traffic system functions "think" they operate on MUPs in the existing telecommunication system, while in reality they are operating on vMUPs which belong to new added switches. The global address space comprises the vMUPs of the added switches as well as the MUPs of the switches of the existing telecommunication system.

As is well known a main task of a connection handler is to set up point-to-point connections. The connection handler in accordance with the invention is added to the traffic control system and hides the added switches for the traffic control functions by translating the global addresses, MUPs as well as vMUPs, into local addresses, MUPs, for the individual switches. If an added switch does not have MUPs but for instance has channels or other logical representations, then a vMUP will address a channel or other logical representation in the respective switch. To summarize; the traffic control uses addresses in the global address space, and the connection handler translates the global addresses into local addresses and operates on the physical inlets of the individual switch.

The connection handler in accordance with the invention is similar to a conventional connection handler that operates on a single switch. However, the functionality connection handler in accordance with the invention is enlarged with functions for selecting the switch or switches to operate and

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functions for operating (set up, monitor and release) inter-switch connections..

As is well known a main task of a call handler is to identify the origin of a call (the caller) and to perform digit analyses in order to establish the destination of the call (the called party). Another task is to identify whether the call is a conventional two party call or if it is a multiparty call. A call handler in accordance with the present invention is similar to a conventional call handler. The call handler in accordance with the invention addresses all of the switches, existing as well as added ones, with the global address space. As mentioned above the global addresses are translated into switch identity and local addresses in the identified switch. The local addresses refer to physical inlets or other logical representations in the identified switch.

The size of the global address space is given by the size of the maximum pointer allowed by the traffic control system and is not depending on the size of switches. Typically the maximum size of a pointer is in the order of about 32 bits, that is 2^{32} addresses depending on the processors used, while a typical switch has 64k or 128 k inlets which need to be addressed. Therefore there is plenty of room available for global addresses in the system.

In the preferred embodiment of the invention the lower part of the global address space is reserved for the existing switch in the controlling node. This is done for compatibility reasons, since certain MUP users, hardware entities as well as software entities, handled by the traffic control system cannot address addresses larger than 64k or 128k. These users require that the addresses used in the global address space are the same as the addresses they used in the old address space in the existing system, before switches were added. In the reserved part of the global address space a group switch MUP, GSMUP, has the same value as its corresponding vMUP. Because the values are the same, the connection handler will perform no translation from vMUP to local MUP for the addresses in the reserved portion. The size of the reserved portion is set either to 64k or 128k depending on the size of the existing switch.

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Above the reserved portion of the global address space the global addresses are allocated one by one or in groups. Typically a group would comprise 32 addresses corresponding to 32 channels of a PCM trunk. In the U.S. a group would typically have 24 addresses; this number corresponding to the number of channels in a T1 system. Preferably the addresses of a group are allocated in a consecutive order.

There are two allocation processes. The first one takes place when hardware is connected to the group switch. Each hardware inlet is allocated a respective MUP. The MUP so allocated is herein referred to as a local MUP or local address. The second allocation process takes place when an additional switch is added to the existing system and comprises two steps. In the first step the global address space is generated and the lower part thereof is reserved. The MUPS of the existing switch are allocated a respective global address. For example the MUP that has the local address ...00001 is allocated the global address ...00001, the one with local address ...00010 is allocated global address ...00010 etc. until all of the MUPS have been given a respective global address. In the second step the local addresses of the physical inlets of the added switches are allocated global addresses above the reserved portion one by one or group wise.

Accordingly the call handler will have the same addressing space as before but it will not be addressing MUPS of a group switch, instead it will be addressing global MUPS. The call handler will, however, not recognise this. To the call handler all of the switches, existing as well as added, will be treated as were they just one big addressable switch. Internally in the connection handler a global address is translated into a MUP, a channel or whatever is the representation of its physical inlet.

Related technique

U.S. Patent Serial No.5,960,004 in the name of Ramström et.al. is example of a software architecture that requires redesign of all of the existing software in the existing telecommunication system in which the new software is used. The development costs for the new software are accordingly high. The new software call model uses logical switch views in order to set up and re-

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lease connections through a telecommunication system. The use of switch views to set up or release a connection requires much processor capacity. Once the new software has been loaded into the system the software will allow for expansion of the telecommunication system with new switches in new nodes.

In accordance with the invention a connection through the expanded telecommunication system is set up, released and manipulated stating the global addresses of the switches. The connection handler sets up, releases, and manipulates connections through the switches and between the switches. This new way of controlling the connections requires less processor capacity in comparison with said U.S. patent to Ramstrom. In accordance with the present invention the inlets of the switches are addressed which is in contrast to the Ramstrom approach wherein the connection is addressed. The Ramstrom patent has a great flexibility. Such flexibility is not required by the present invention. Therefore the solution of the present invention is not as capacity demanding as Ramstrom.

In order to fully understand the claims, the description and the merits of the invention some expressions must be clarified and some characteristics of the invention must be made clear.

Definitions

In switch technology it is not proper to say that a switch has an input side and an output side, since each side of a switch can receive as well as send away a call. Instead a switch is said to have a number of inlets. Each inlet has an input and an output. An inlet is a two-way entity. Between two inlets either a two-way or a one-way connection can be established. A two-way connection will be using the input and the output of an inlet, a one-way connection only one of these.

Inventive features

The telecommunication system of the present invention comprises two or more nodes. One node (referred to as an internal node or an existing node or a controlling node) controls one or more switches (also referred to as one or

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more added switches) that are resident in one or more other nodes. The other nodes are referred to as external nodes or media gateways.

The existing node can control the entire or only a part of the added switch or switches in an external node. An external node may have other traffic that is controlled by its own traffic control system, said other traffic is thus not controlled by the control node.

The bearer services used by the switches in the existing node may be of one type which is different from that used in an external node. The telecommunication system may thus comprise mixed types of bearer services, such as STM, ATM and IP.

All external nodes have a common format for the manner in which they present or publish themselves to the controlling node. As an example this format is the identity ID of the inlet group and the identity ID of the particular inlet in the identified group. In some switch systems an inlet group is referred to as a switch device and the particular inlet of the identified switch device is referred to as channel.

The existing node may comprise a group switch and a subscriber switch stage. This being the case the group switch is controlled by group switch multiple points (GS MUPS) and the subscriber switch stage is not controlled by global addresses but by control store positions.

A portion of the global address space is reserved for the local address space of the controlling node. The reserved portion starts at address 0 and ends at address X, X being a parameter the value of which depends on at least three motives that optionally may be used separately or in combination. One such motive is that the new software used for control of connections, this software being referred to as a connection handler, shall be backwards compatible with old users (such as old trunks) of the addresses in the local address space of the existing node. Such old users may not, depending on the particular case, be able to handle the large global address space proposed by the invention. The reserved portion is therefore made equal to the address space the old users are capable of handling. A second motive is to reduce processor capacity by using, in the reserved portion of the global address

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It should be noted that in case there are no old users to consider, that is there is no need to provide back-compatibility, then X can be zero which means that no portion of the global address space is reserved.

Description of the drawings

FIG 1b Is an overall view of the node of FIG. 1a enhanced in accordance with the invention to provide an expanded telecommunication system in accordance with the invention,

FIG 2 is an overall view of the invention showing a controlling node controlling its own STM switch as well as an external ATM switch and

an interconnection trunk, said entities together forming a telecommunication system in accordance with the present invention,

FIG 3 is showing the hardware configuration of the controlling node in FIG 2 as seen from access point of view,

Fig. 4 is showing the hardware configuration of the system of Fig 2(?)

FIG 5 is showing a layered structure of the telecommunication system in accordance with the invention,

FIG 6 is showing how the connection handler controls the hardware interfaces

FIG 7 is an overall view of the system of FIG 2 wherein nine basic call cases have been illustrated,

FIG 8 is a simplified view of the system shown in FIG 2 wherein the nine basic call cases of Fig 6 have been reduced to three, two of which are identical from connection layer point of view,

FIG 9 illustrates the global address space, gMUP range, and how portions thereof (GSMUPs, vMUPs, GSMUPs, GSMUPs/vMUPs) are assigned to different switches (the ATM switch in MG, the group switch GS, another external switch in the telecommunication system of the present invention and, to the left the internal switch in the controlling node,

FIG 10 is illustrating a file having in its middle column the local address spaces of the switches of the present telecommunication system, in its left column the global addresses in the global address space, and in its right column the switch identities; this file being shown by the shaded portion, and this file showing the allocation of local addresses to global addresses and the switch IDs,

FIG 11 is a view showing a call example wherein a call is set up between users GMUP1 and vMUP1 residing in switches belonging to two different nodes, the group switch GS in the controlling node and the ATM switch in the external controlled node, this Figure showing sig-

nalling between the indicated entities of the telecommunication system,

FIG 12 is a similar view to FIG 11 and illustrates the release of the call that was set up in FIG 10,

Fig 13 is a view similar to Fig 11 and illustrates connection case 3 shown in FIG 8, and

FIG 14 is a view similar to FIG 13 and illustrates how the call set up in FIG 12 is released.

Detailed description of the invention

In the following detailed description a controlling node is the controlling node referred to in the claims, call handler is the call handler referred to in the claims and connection handler is the connection handler referred to in the claims. Media gateway (MG) is the external node or other node referred to in the claims.

A telecommunication system shown in FIG. 1a can be described as consisting of three layers, a call handler layer 1, a connection handler layer 2, and a bearer service layer 3. In the bearer service layer switches 4 and other types of hardware (HW) will be found as well as HW drivers for this equipment. In the connection handler layer, there will be generic functions to relay requests for HW manipulation to the proper HW driver.

The call handler layer handles all the traffic control functions and decides what HW connections should be done based on information e.g received via trunks 5.

Below is described how a node consisting of all these three layers can be further developed in the connection handler layer to control a multitude of switches, both in the own bearer service layer as well as in other nodes/ machines, i.e. external switches, without affecting an existing call handler.

A node, referred to as a controlling node 6, in a telecommunication system 7 comprises a call handler 8, sometimes also referred to as a traffic control system, and a connection handler 9.

The controlling node controls HW in another node 10. Said HW comprises one or more switches 11. If said other node 10 uses another transmission technique than that used in telecommunication system 7 then said controlled HW in said other node is referred to as a media gateway (MG) 12. Refer to FIG. 1b. In the embodiment described the system 7 is a STM system (synchronous transmission mode) while the other node is part of an ATM system (asynchronous transmission mode).

The STM based controlling node has a wide variety of applications and an STM based connection handler. The ATM based other node supports only a limited set of services. The idea in system design is to use both nodes as one combined telecommunication system, using the switching capabilities of both switches 4 and 11, as well as application call services supported by the controlling node. The nodes 6 and 10 will not be integrated, they will rather be built as a "loosely coupled node", so to make possible various independencies (separate projects, separate operation and maintenance systems (O&M systems), and independent development of systems. From a traffical point of view, the telecommunication system can be perceived as one transit node. By reusing STM HW in the controlling node, there will also be need for a speech carrying bearer between the controlling node and the MG 12. This speech carrying bearer is an interconnect trunk, IT, 13.

This invention defines an evolution of the connection handler in the controlling node so it can control connections both in the controlling node and in the MG. The control will consist of e.g. setting up and releasing paths within the different switches, as well as controlling the interconnect trunk between the controlling node and the MG.

FIG 1a, shows the existing telecommunication system 6 and FIG 1b, shows how the telecommunication system will be expanded with new external switch(es) 11 which is controlled from the existing controlling node 7.

In FIG 2 it is shown how the controlling node 7 is controlling (i) its own STM switch, (ii) an external ATM switch and (iii) the interconnect trunk 13.

Although the invention will be described with reference to an example wherein an STM system is extended to a combined STM/ATM system the in-

vention is not limited to this but its principles can be used for introduction of new switches for any bearer types, based on a call control adapted to any other bearer services. STM and ATM are used purely as an example.

In FIG 3, the basic HW modules in the controlling node before the new switch technology is shown. The controlling node 7 comprises the switch 4 and the trunks 5 connected thereto, the ATM switch 12 in the MG and trunks 14 connected to the ATM switch. The interconnection trunk 13 extends between switches 4 and 12. In the example shown the controlling node is designed to handle STM based traffic. the call handler in the call layer will order the connection handler to operate on the switches 1, 12 in the combined STM/ATM system.

The connection handler will send switching orders to the switch 4, which in the illustrated embodiment is a group switch 16, GS, so as to create paths between inlets of the GS. Over said paths is speech carried between two different multiple positions, MUPs, in the switch. If the call is going through several switches, for example switches 4 and 11, the call handler will send individual orders to all these switches. The switching order is sent over a control link 15. The connection handler in the controlling node will then address and control all these switches. The group switch is shown in more detail in FIG. 3 and comprises exchange terminals (ET) 16, a central processor (CP) 17 and pooled devices 18. An ET is an access device that handles time slots between a switch and a trunk connected to the switch. Pooled devices comprise different groups (pools) of devices. Examples of devices are tone senders, announcement machines, conference equipment, digit senders, and digit receivers.

Group Switch Traffical Interface

Switch control for the GS and ATM switches is performed by the connection handler in the controlling node. When an application, for example a telephony application, wishes to manipulate a switch it should use only the specified user interface implemented by the connection handler.

The group switch provides a number of services to select, operate and release narrow-band paths in the group switch. The paths can be one-way,

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Any other special speech handling hardware like message sender, DTMF receiver, tone sender, conference equipment etc. is connected as pooled de-

vices to the group switch. These types of equipment are only available in the controlling node.

The controlling node has Ethernet hardware to carry the control link which will carry the orders sent from the controlling node to the MG.

The access in MG are ATM and STM as evidenced by trunks 5 and 14. The STM is implemented as circuit emulation in the ET/CE. The voice and data connection between MG and the controlling node, i.e. over the interconnect trunk 13, should be done using the ET/CE devices shown.

The switch in the MG is an ATM switch. This switch only supports one-way or both-way connections. No monitoring can be performed. Supported ATM coding is AAL1 only. The CE/ET devices will pack and unpack one 64 kbit/s channel into one AAL1 channel.

The control link 15 is based on TCP/IP/Ethernet. A non illustrated central processor in MG 11 has the necessary HW and protocol stacks.

The connection handler and the ETs in the controlling node will see the MG as its extension, while existing parts of the MG will not be very much aware of the presence of the controlling node.

FIG 5 illustrates the general software as well as hardware structure of the combined switch shown in FIG 4. The general hardware general structure is shown with shaded rectangles.

The ATM switch, as perceived from telephony applications in the controlling node, will look like an extension of the group switch GS. Connection operations performed on the ATM switch have to be similar to those performed on the group switch GS so as not to make the connection handler too complicated. Access equipment, ETs and Ces, to the MG has to be seen as ordinary controlling node ETs for telephony applications in the controlling node.

A logical switch 22 is a software implemented switch emulator (SE) included in a switch emulator subsystem (SES) 23 of the MG. A main task of SES 23 is to translate STM based control orders from the controlling node into ATM based control orders that are understood by the physical ATM switch. It communicates with the controlling node in "STM language" and

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The trunks in the controlling node will perceive the vET as a local controlling node ET, and will not be aware of the absence of hardware realised ETs. The call handler will use the connection handler as usual to operate the switching equipment. The connection handler will use the logical switch in SES as a hardware-realised switch. In this way telephony applications in the controlling node will have full control over the MG connections both from access point of view and from call control point of view.

The interconnect trunk IT comprises of a number of STM narrowband channels. The channels are terminated in ET on the controlling node side and in CF on the MG side. It will occupy a range of MUPs on the controlling node side (GS) and also a range of channels grouped within switch devices on the MG side. Examples of switch devices are shown in FIG 6 and comprise tone senders, tone receivers, 3-party devices (conference equipment), group switch.

There are two main alternatives to implement the inventive telecommunication system described above. One is to adapt the existing implementation so that trunk blocks with accesses in MG will be using the switch view technique shown in U.S. Patent Serial No.5,960,004 referred to above.

Trunks will use MUPs in a conventional manner. A MUP will represent a resource either in the controlling node or in MG. A MUP will be used by the call handler in a conventional manner.

MUPs that are used for addressing the controlling node and the MG resources have to be unique. This implies that the range of MUPs belonging to the MG must not overlap the MUP ranges that already exist within the controlling node.

A vMUP represents an inlet in an external switch and consists of switch identity and channel.

The reasons why such a reservation is made are the following :

The controlling node users (trunks, call handler) will see only gMUPs. When, for example, the call handler wants to operate a path, the MUPs sent by the call handler and received by the connection handler will be translated into local MUPs plus references. Further, the connection handler will establish

the path through the group switch and/or external switch and, if applicable, also over the interconnect trunk, IT. A typical set up of a path from a subscriber A to a subscriber B through the controlling node and the MG is described below with reference to FIG 11 which illustrates connection case 1. An initial address message (IAM/IFAM message) is received by an ISUP/TUP part in the call handler. The MUP on which this message is received is known to the trunk. This MUP is labelled MUP1. Next the trunk seizes the call handler with the GMUP for MUP1. Next the call handler performs digit analyses of the B-number. Since the B-number does not belong to a subscriber connected to the GS, an outgoing trunk, which leads to the B-number, is selected by the call handler. This outgoing trunk is seized. One data item received by the call handler in response to the seizure of the trunk is the vMUP1 to which user B belongs. Next the call handler starts to set up a path between MUP1, which corresponds to user A, and vMUP1, which corresponds to user B. The call handler sends an order to select and operate path GMUP(MUP1); GMUP(vMUP1) to the connection handler. The connection handler must now analyse if these GMUPS belong to the same switch or not. Since they do not belong to one and the same switch a path must be set up between the involved switches. The connection handler therefore next seizes the interconnect trunk. In response to this seizure the connection handler receives two MUPs, in this case GMUP(MUP2) and GMUP(vMUP2). Also the individual identity of the seized interconnect trunk is received. Now the connection handler has knowledge of the four switch positions. The path through the interconnect trunk is already established and what still needs to be done is to set up the two paths through the two switches. Next the connection handler sends an order, "Establish path (EXT1, EXT2)" to the ATM switch (rather to the logical switch (SE)) requesting it establish the MG part of the path. In response to this the connection handler receives the result, "path established", of request. Next the connection handler sends an order "select and operate path MUP1; MUP2" to the GS. That is the controlling node part of the path. In response to this the connection handler receives the result, "path established", of request. This completes the path between subscriber A and subscriber B.

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Release from the A side (subscriber A) is shown in FIG 14. When the call handler has received a release order, it orders release of the switch path towards the incoming side. At the same time the call handler releases the outgoing side. The connection handler receives an order "Release path GMUP(vMUP1), GMUP(vMUP2)" from the incoming side and releases the switch path.

ASV	Access Switch View
ATM	Asynchronous Transfer Mode
CE	Circuit Emulation
CH	Channel
CS	Combined Switch
COS	Connection Service Subsystem
DTMF	Dual Tone Multi-Frequency (Signalling)
DR	Digit Receiver
EC	Echo Canceller
ET	Exchange Terminal

ETC	ET Controller
gMUP	Global MUP
GS	Group Switch
GSH	GS Handler
HW	Hardware
IAM	Initial Address Message
IFAM	Initial and Final Address Message (TUP message)
IN	Intelligent Network
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IT	Interconnect Trunk
MG	Media Gateway,
MS	Message Sender
MUP	Multiple Position
O&M	Operation and Maintenance
PCM	Pulse Code Modulation
SCP	Switch Control Protocol
SD	Switch Device
SDH	Synchronous Digital Hierarchy
SDId	Switch Device Identity
SE	Switch Emulator
SES	Controlling node Logical switch Subsystem
STM	Synchronous Transfer Mode
SW	SoftWare
TC	Traffic Control
TS	Tone Sender, Time Switch
TUP	Telephony User Part
vET	Virtual Exchange Terminal
vMUP	Virtual MUP